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Delayed chest radiographs and the diagnosis of pneumothorax following CT-guided fine needle aspiration of pulmonary lesions

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We prospectively studied 64 consecutive patients on whom computerized tomography-guided fine needle aspirations (CT-FNA) of pulmonary lesions were performed to determine whether obtaining a delayed chest radiograpy (CXR) after CT-FNA is helpful in the diagnosis of post-procedure pneumothorax (PTX). Two of the 64 patients developed a delayed PTX. Only one of the patients with a delayed PTX required chest tube drainage. If patients have no evidence of a PTX immediately after a CT-FNA by CT scan then a delayed CXR adds little to care of these patients.

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Introduction

Computerized tomography-guided transthoracic fine needle aspiration (CT-FNA) is an effective, simple, and accurate diagnostic method for the evaluation of pulmonary lesions. Adequate samples of tissue can be obtained in 74–100% of CT-FNA of pulmonary lesions with a diagnostic accuracy of 81–99% (1–3). This procedure is of relatively low cost with acceptable risks for mortality and morbidity.

Pneumothorax (PTX) is the most common complication of CT-FNA of pulmonary lesions. The reported incidence of PTX as a complication of CT-FNA of pulmonary lesions varies widely from 8–61% (1,4–6). However, it is not known how often PTX presents immediately following the procedure or as a late complication. The operator's concern about potential delayed PTX development has lead some clinicians to order post-procedure chest radiographs (CXR). This practice has not been determined to be necessary or cost-effective.

Materials and Methods

With Institutional Review Board approval, 64 consecutive patients who were to have CT-FNA of a pulmonary lesion were offered inclusion and agreed to participate in this prospective study.

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A 22-gauge Chiba needle (Boston Scientific Corporation, Waterton, MA, U.S.A.) was used for aspirating the pulmonary lesions in all cases. Cytological examination of obtained material was carried out immediately to determine if additional aspiration attempts were necessary. After completion of CT-FNA each patient was re-imaged with two addional views with the CT scanner (Picker PQ 2000, Cleveland, Ohio, U.S.A.) to check for PTX. An expiratory CXR was obtained on each patient 4 h later. The percentage of patients who developed a PTX, the size of the PTX, whether it was identifiable immediately or was delayed, and what intervention, if any, was undertaken were recorded. When intervention was clinically indicated a small bore catheter (Arrow International, Reading, PA, U.S.A.) was placed anteriorly into the second intercostal space. All patients requiring chest tube insertion were admitted to the hospital.

The patient's age, sex, and the degree of obstructive lung disease as measured by pulmonary function testing were recorded. The position of the patient (prone, supine, or lateral decubitus) at the time of biopsy, the lobe of the lung in which the lesion was located, the number of needle passes taken into the each lesion, the depth of needle penetration, and the size of the pulmonary lesions were also obtained.

Statistical Analysis

Differences between the patients that developed PTX and those that did not were analysed statistically by performing the two-sample *t*-test. Differences in the frequencies of dichotomous parameters were analysed by Pearson's chi-square analysis. A *P*-value of 0.05 was accepted as statistically significant.

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Table 1. Development of PTX following CT-FNA

Total patients (*n*)	64
No PTX (*n*)	51
PTX (*n*)	13
Immediate PTX	11
No intervention	8
Intervention	3
Delayed PTX	2
No intervention	1
Intervention	1

Results

All patients were male with a mean age of 67 ± 8 years. Thirteen of the 64 patients (20%) developed a PTX (Table 1). Eleven (85%) of the PTXs were noted immediately with post-procedure CT imaging. Chest tubes were placed in three patients who experienced shortness of breath and/or chest pain. PTX was delayed and identified on post-procedure expiratory CXR in two patients (3·1%). One of the patients with a delayed PTX required intervention (1·5%).

There was no statistically significant difference between the patients that did and did not develop a PTX with respect to age, the lobe of the lung sampled, the position of the patient at the time of biopsy, the depth of needle penetration, or the number of needle passes (Table 2 and 3). Forty-one of the 64 patients (64%) had documented chronic obstructive pulmonary disease (COPD) of varying severity. Although there was no significant difference in the degree of COPD between the patients who did and did not develop PTX, all the patients that required chest tube intervention had severe to very severe obstructive airway disease [forced expiratory volume in 1 s (FEV_1) less than 50% of predicted]. Due to the small number of PTX, a larger sample size may be necessary to test the reliability of this observation.

The size of the parenchymal lesion was the only factor that was statistically differrent between those patients who did and did not develop a PTX. Those patients that sufferred a PTX typically had a smaller pulmonary lesion ($P=0·02$).

Table 3. Statistical analysis comparing patients who did and did not develop PTX following CT-FNA using Pearson's chi-square test

	Statistical significance
Lobe of lung involved	n.s.*
Position of patient	n.s.
Degree of COPD	n.s.

*n.s.=no significant difference.

Discussion

The leading cause of iatrogenic PTX is transthoracic needle aspiration of pulmonary lesions (7,8) The reported incidence in general falls into the 40% range (1,3,6,9,10). The reason our patients experienced a lower number of PTXs (20%) is not clear but may be related to the size of the lesions that were sampled. Chest-tube intervention for FNA-induced PTX is reported to be necessary in 2–21% of cases (3,6,10,11). Four of our 64 patients (6%) required chest-tube drainage, which is consistent with this observation.

Patients with obstructive lung disease appear to have a higher rate of PTX following CT-FNA when compared to patients with normal lung function (11–13). Other authors suggest that it is not the degree of measured airflow obstruction but the alveolar hyperinflation associated with bronchial obstruction that increases the risk (10,14). Still other authors argue that the degree of COPD does not contribute to the development of a FNA-associated PTX but that chest-tube placement is needed more frequently in patients with obstructive lung disease (6,9). While there was no significant difference between our patients who did and did not develop PTX, our data suggest that chest-tube intervention is more likely to be necessary in patients with severe degrees of airway obstruction.

The depth of needle penetration required to sample a pulmonary lesion has been demonstrated to be a significant predictor of the occurrence of PTX (6,10). The increased frequency of PTX may be due to the crossing of additional

Table 2. Statistical analysis comparing patients who did and did not develop PTX following CT-FNA using the two-sample *t*-test

Patients undergoing CT-FNA (*n*=64)	No PTX (*n*=51) (mean ± SD)	PTX (*n*=13) (mean ± SD)	Statistical significance
Age (years)	68·5 ± 7·5	65·5 ± 9·3	n.s.*
Depth of needle penetration (cm)	5·5 ± 1·5	5·7 ± 1·5	n.s.
Number of needle passes (cm)	1·7 ± 0·7	1·9 ± 0·6	n.s.
Lesion size (cm)	3·7 ± 2·5	2·6 ± 1·2	$P=0·02$

*n.s.=no significant difference.

tissue planes with deeper needle penetration. Alternatively, with deep penetration the needle may be less stable with respiratory movements causing greater stresses at the point of entry into the thorax. When a CT-FNA needle does not traverse aerated lung the likelihood of PTX is also decreased (5).

The size of the lesion undergoing CT-guided FNA was a significant risk factor for PTX in our population. This observation has been previously demonstrated (6,9). The reasons that a small lesion may be a risk factor for PTX include a diminished ability to obtain adequate tissue necessitating multiple needle passes with multiple pleural interruptions. Similarly, larger parenchymal lesions may more closely approximate the chest wall by their size, decreasing the required depth of needle penetration. While not statistically significant, our data show that a higher number of needle passes and deeper needle penetration were required in patients with smaller lesions who developed PTX.

Positioning the patient into the lateral decubitus position has been shown not to alter the rate of post-FNA PTX or the proportion of patients who will require intervention for this complication (15). Our data confirm this observation. In addition, there was no difference in PTX rate when patients were placed in the prone or supine position or in consideration of what lobe of the lung was biopsied.

While treatment of the post-biopsy PTX has traditionally been with large-bore (22–32 French) chest tubes, small catheters are less traumatic and troublesome than the large intercostal chest-tube drainage (16). Small-caliber intercostal catheters (8 French) were used successfully in each of the four patients who required drainage of their PTX. This reinforces the previously reported observations that small-bore percutaneous catheters can effectively and easily treat post-biopsy PTX (16,17).

The practice of obtaining a delayed post-procedure CXR after CT-FNA is not an efficient use of resources or the patient's time. CXR imaging adds little information regarding lung expansion to that obtained by CT at the end of the CT-FNA. In our study, the risk of missing a PTX which required intervention by omitting delayed CXR imaging was less than 2%. Patient instruction to seek medical attention in the event of symptoms of PTX would be a more effective method of addressing this potential complication.

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